The electronic cigarette
(personal nicotine vaporizer)

Murray Laugesen

Health New Zealand Ltd
nicotine and tobacco product researchers

www.healthnz.co.nz

Christchurch, New Zealand

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Respects to the indigenous people and a note on pituri

- In Australia smokeless tobacco (pituri) has been gathered from certain shrubs and treated with ash for thousands of years. Tobacco leaf is chewed in other indigenous communities. (Tom Calmo) Pituri contains nicotine and appears to discourage protect some communities from smoking.

a) Pituri deserves serious chemical and toxicological research. What if any carcinogens are in pituri? Can they be removed? What else does it contain besides nicotine?
b) Pituri use could be affirmed and protected for indigenous communities.
b) Pituri be investigated as a possible ally in reducing the high tobacco smoking prevalence among indigenous communities.
c) The rights of indigenous people to traditional drugs and remedies such as pituri and patents deriving therefrom be protected in Australian law.
d) Although Australian law bans sale of smokeless tobacco, and taxes imports for personal use, indigenous communities should be given the right to trade pituri as a commodity if they wish, and pay no tax.
NZ End game website

- [www.endsmoking.org.nz](http://www.endsmoking.org.nz)

End Smoking NZ trust  founded 2006

Dedicated to the **phase-out of cigarette and tobacco sales** by 2020.
**Not prohibition**: no ban on home growing for personal use.
E-cigarette research funding

- E-cigarette safety tests were funded by Ruyan through Health New Zealand Ltd, who then contracted with laboratories in New Zealand and Canada.
- Duke University, North Carolina and British American Tobacco research division (UK) contributed analyses at no cost.

*Disclaimer:* Health NZ has no financial interest or otherwise benefits from any tobacco, pharmaceutical or nicotine company.
Ruyan V8 classic e-cigarette
E-cigarette, first of a new product class of flameless nicotine “cigarettes”

- Invented 2004 by Hon Lik
- Patent for atomiser owned by Ruyan
- Sells best in countries where cigarette prices and health concerns high.
- Operating temperature 54C maximum
- Battery generates 0.1mW
- Propylene glycol 0.8 g /cartridge the solvent
- Nicotine 16 mg, 11mg, 6 mg, 0 mg /cartridge

More at www.healthnz.co.nz/ecigarette
and at www.endsmoking.org.nz
The research question:
Does it give a safe and satisfying smoke?

• Marketed as cigarette substitutes;
• Claim to deliver nicotine without smoke toxicants and the risks of smoking.

We ask:
1) Is this product safe – relative to cigarettes and in absolute terms?

2) Is this product efficacious? Does it relieve cravings and does it raise blood nicotine?
Is this product safe – relative to cigarettes and in absolute terms?

Relative risk:  Is it safer than smoking?
Emissions comparisons.

Absolute risk:  Does it pose new risks?

Other risks  Child safe?
Cross-infection?
Laboratories involved

• **NZ:**
  – Environmental Science and Research Institute (ESR), Porirua.
  – Hort Research, Hamilton
  – Lincoln University, Canterbury.
  – Syft Analytics Ltd, Christchurch
  – Hills Laboratories, Hamilton

• **CANADA** Labstat International, Ontario, Canada

• **USA**
  – Center for Nicotine and Smoking Cessation Research, Duke University, NC, USA.

• **UK**
  - British American Tobacco Group R&D, UK.
E-cigarette mist tested for 62 smoke toxicants: 11 measurable

- **Aldehydes**
  Acetaldehyde, butyraldehyde, crotonaldehyde, formaldehyde.

- **Ketones:**
  Acetone, methyl ethyl ketone

- **Metal:** Mercury

- **Tobacco-specific Nitrosamines**
  NNK, NNN NAT
FDA doesn’t know if e-cigarettes any better than cigarettes

• (E-smoker:) "This is something the government should be pushing for, a clean way of allowing people to smoke," Woessner said.

• Delancey (FDA) disagreed. "I feel their pain," she said. "We don't know if this (e-cigarette) is any better for them." (than cigarettes)

• Jim Merkel. Users love e-cigarettes but FDA wants to take a closer look. *St Louis Today* 30 Sep 2009  
http://suburbanjournals.stltoday.com/articles/2009/10/01/south/news//0930sc-ecig0.txt
FDA findings on e-cigs July 2009

Released 25 Jul 2009- Preliminary report
• Variation between cartridges in nicotine dose.
• One cartridge of Smoking Everywhere brand contained about 1% diethylene glycol (DEG).
• Some cartridges contained traces of tobacco specific nitrosamines.
• N-Joy brands contained traces of nicotine impurities eg beta-nicotyrine.
### Carcinogens (TSNAs) in e-cigarettes - FDA

<table>
<thead>
<tr>
<th>ng/g</th>
<th>TSNAs per piece</th>
<th>Maximum exposure / day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruyan cartridge 16mg Labstat 2007</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>CQ patch 4 mg Stepanov 2006</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Nicorette gum 4 mg Stepanov 2006</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Marlboro Red regular <a href="http://www.endsmoking.org.nz/snuffregulations.htm">www.endsmoking.org.nz/snuffregulations.htm</a></td>
<td>6 600</td>
<td>81 200</td>
</tr>
</tbody>
</table>
FCTC mandated reductions for top 9 toxicants asked for by WHO TobReg in 2008: achievable now by e-cigarette

Nicotine adjusted
### Toxicants levels in smoke >> mist

<table>
<thead>
<tr>
<th>Toxin</th>
<th>Per cigarette, or Per e-cigarette of same puffs</th>
<th>Marlboro Regular</th>
<th>E-cigarette</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aldehydes</strong></td>
<td><strong>microg (ug)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td></td>
<td>458</td>
<td>4</td>
</tr>
<tr>
<td>Butyraldehyde, Formaldehyde</td>
<td></td>
<td>29, 27</td>
<td>2</td>
</tr>
<tr>
<td>Crotonaldehyde</td>
<td></td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td><strong>Ketones</strong></td>
<td><strong>microg (ug)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetone, Me Et Ketone</td>
<td></td>
<td>262, 58</td>
<td>44</td>
</tr>
<tr>
<td><strong>NNN, NNK, NAT</strong></td>
<td><strong>ng</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>ng</td>
<td>2.8</td>
<td>0.17</td>
</tr>
<tr>
<td>Chyrsene PAH</td>
<td>ng</td>
<td>3.7</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Cigarette smoking increases breath and alveolar CO: vaping does not
The e-cigarette: low nicotine

Active ingredient: Nicotine
Dose 10 micrograms / puff
Absorption site Upper respiratory tract
Count median diameter (CMD) 40 nm
< cigarette CMD
Nicotine content < label says

- Full strength: 16 mg (Label 12.9 mg, Test 11 mg)
- Medium: 9.3 mg (Label 11 mg, Test 6 mg)
- Low: 5.1 mg (Label 6 mg, Test 0 mg)
- Zero: 0 mg (Label 0 mg, Test 0 mg)
<table>
<thead>
<tr>
<th></th>
<th>Cigarette Marlboro Regular</th>
<th>NRT Inhaler Nicorette</th>
<th>E-cigarette Ruyan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>13 mg /cigarette</td>
<td>10 mg /cartridge</td>
<td>13 mg /cartridge</td>
</tr>
<tr>
<td>Nicotine purchased for 1 day’s use</td>
<td>260 mg (1 packet)</td>
<td>60 mg (6 carts.)</td>
<td>13 mg (1 cartridge)</td>
</tr>
</tbody>
</table>
## Nicotine delivery

<table>
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<th>E-cigarette Ruyan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery / 35 ml puff</td>
<td>0.1 mg</td>
<td>0.01 mg</td>
<td>0.01 mg</td>
</tr>
</tbody>
</table>
## Nicotine content, delivery, absorption

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<td><strong>Delivery / 35 ml puff</strong></td>
<td>0.1 mg</td>
<td>0.01 mg</td>
<td>0.01 mg</td>
</tr>
<tr>
<td><strong>Absorption /10 puffs</strong></td>
<td>1.0 mg</td>
<td>?0.05 mg</td>
<td>?0.05 mg</td>
</tr>
<tr>
<td><strong>Absorption %</strong></td>
<td>100%</td>
<td>? 50%</td>
<td>? 50%</td>
</tr>
</tbody>
</table>
Nicotine per puff, mist v. smoke

- Ruyan V8 e-cigarette: 9 micrograms
- Supersmoker mini E-cigarette: 14 micrograms
- Marlboro Red regular: 147 micrograms

Comparison of nicotine content in different products.
Clinical trial of e-cigarette efficacy

• by Clinical Trials Research Unit University of Auckland, 2008. N=40.
• No previous experience using e-cigarette. Norms not known for e-cig puffing.
• After overnight abstinence, inhale product.
• Ask “How much do you want a cigarette right now?” Marked on scale 0 to 10.
• Blood nicotine over 1 hour. N = 9
• Observed for 8 hours, reactions noted.
Efficacy. Does the e-cigarette relieve cravings?

• When puffed like a cigarette for 5 minutes, relieves cravings, but less than own cigarette.
• Smoking reduced to 2 cigarettes on first day (without anyone intending to quit)
• E-cig acts more rapidly than Nicorette inhaler, but not as rapidly as own cigarette.
Cravings relief by product, after overnight abstinence from smoking
Cravings relief from medicinal inhaler, e-cigarette, own cigarette

![Cravings relief graph]

**Graph Title**: Cravings relief from medicinal inhaler, e-cigarette, own cigarette

**X-axis**: Minutes after first cigarette

**Y-axis**: Cravings for a cigarette

0 mg e-cigarette

16 mg e-cigarette

Nicorette

Own cigarette

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## Pharmacokinetics
Cigarettes puffed 5 mins; Nicorette puffed for 20 minutes.

<table>
<thead>
<tr>
<th></th>
<th>T max (minutes)</th>
<th>C max ng / ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own brand cigarette</td>
<td>14.3</td>
<td>13.4</td>
</tr>
<tr>
<td>Ruyan e-cigarette</td>
<td>19.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Nicorette inhaler (10 mg)</td>
<td>32.0</td>
<td>2.1</td>
</tr>
</tbody>
</table>
Serum Nicotine after inhaling

- S. Nicotine increases 4 ng/ml in 7 minutes in this e-smoker.
- S. Nicotine increases 20 ng/ml in 8 minutes in this smoker
Patent law enforcement necessary for registration as a medicine

- Ruyan holds world patent applications for atomiser.
- Sales going to copycat companies, undercutting Ruyan’s price.
- World sales were estimated at US$100 million annually in 2008.
- Low cigarette prices in China make sales economic only in West.
- Ruyan has prosecuted several rivals successfully under IP law.
- Cigarette companies have the resources to improve reliability and nicotine delivery of the product, but cannot sell without a patent.
- No e-cigarette has been approved as a medicine by any regulator.
- Without enforcement of IP law by the patent holder in China and importing countries, even the patent holder cannot afford to register any e-cigarette as a medicine.
- No registration as a medicine expected for Australia and NZ for 3 years. Meantime personal-use imports permitted into NZ.